DRAFT Technical Memorandum

Upper Petaluma River Watershed Flood Control Project Scoping Study

Subject: **Conceptual Alternatives Screening Evaluation**

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1 Introduction

The Sonoma County Water Agency (Water Agency) is presently undertaking a Scoping Study within the Upper Petaluma River Watershed (Project) to identify stormwater management/groundwater recharge projects that provide flood hazard reduction and groundwater recharge benefits (Key Project Purpose). The Scoping Study is in its initial phase of developing project objectives, assessing potential project issues, designing a stakeholder coordination process, and identifying and prioritizing potential project concepts.

The purpose of this memorandum is to summarize the screening and prioritization process for the Study and apply that process to the project concepts identified in the memorandum entitled *Project Concepts Identification and Description*. The goal of the screening and prioritization process is to create a prioritized list of project concepts to carry forward into the feasibility study phase of the Project. These selected concepts will form the basis of projects to be evaluated for implementation feasibility. Other project elements are anticipated to be included in the project description to potentially improve public and regulatory acceptance and to increase opportunities for receiving outside funding.

2 Screening and Prioritization Process

A two-step screening and evaluation process is proposed for the Study. The goal of the first step is to identify which, if any, project concepts are not appropriate for this Project. The goal of the second step is to prioritize the remaining concepts to identify the preferred concepts for further consideration during the feasibility study phase of the Project.

2.1 Step 1: Screening

In the first step of the screening and evaluation process, project concepts are evaluated with regards to the Key Project Purposes, flood hazard reduction and groundwater recharge benefits. In brief, projects to be considered for inclusion in the feasibility study phase of the Project must provide benefit for both flood hazard reduction and groundwater recharge. Project concepts that do not provide benefits in both of these areas are not included in the prioritization process. It is important to note that exclusion from the prioritization process does not necessarily mean that the concept is without merit or that the Water Agency shouldn't pursue the concept outside of this Project or support the efforts of other entities to pursue the concept. It simply indicates that the concept is not suitable for implementation through this Project. **Table 1** summarizes the results of this screening process.

Table 1: Screening Process Results

Concept	Advanced to Prioritization Process	Notes
Managed Floodplain	Yes	
Off-stream Detention Basin	Yes	
In-stream Detention Basin	Yes	
Floodplain Modification	Yes	
Levee/Floodwall	No	The concept does not address the Groundwater Recharge objective. The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Channel Modification	Yes	
Bypass Channel	Yes	
Bridge Improvement & Debris Removal	No	The concept does not address the Groundwater Recharge objective. The concept does not provide additional infiltration surface, improve surface characteristics for recharge, or detain water for additional percolation time.
Low Impact Development	Yes	
Policy Review & Development	Yes	
Direct Recharge Wells	No	The concept does not address the Flood Hazard Reduction objective. Water diverted for recharge through wells is inconsequential compared to the flood flows.

Based on this evaluation, eight of the eleven identified concepts are considered in the prioritization process.

2.2 Step 2: Prioritization

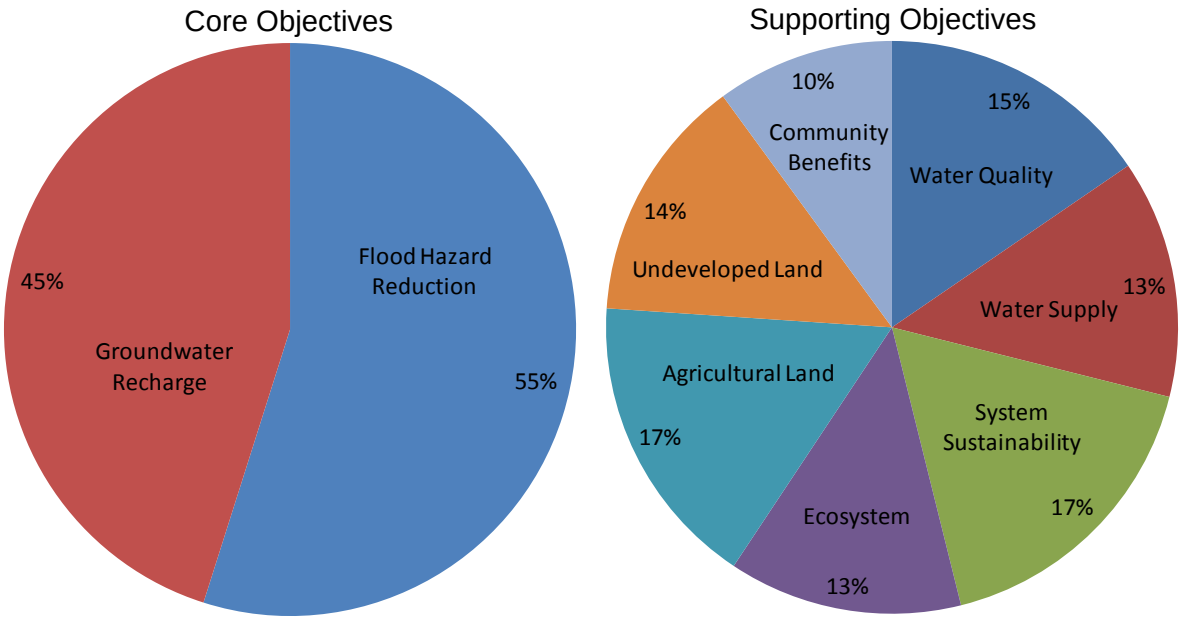
Concepts that passed the initial screening are prioritized utilizing the objectives described in the *Project Objectives Report*. In order to do this, two separate evaluations must take place:

- Weight of objective importance relative to other objectives; and
- Ability of each concept to fulfill the objective relative to the other concepts.

2.2.1 Objective Weighting

Weighting of objectives can be highly subjective and influenced by the evaluator's own biases. Ideally the objective weighting should reflect the interests of the region for which the project is intended. To get a sense of public interests, RMC polled attendees of the October 5, 2011 public workshop. Attendees were asked to prioritize (high, medium, low) elements of the two core objectives and seven supporting objectives. High ratings were given a score of three; medium ratings were given a score of two; low ratings were given a score of one; and no responses were given a score of zero. **Figure 1** summarizes the results, which are based on 28 responses, and represents relative objective importance.

Figure 1: Public Input on Relative Objective Weights



Note: Percentages may not sum to 100% due to rounding.

As indicated by **Figure 1**, the survey is not used to relate the importance of the core and supporting objectives to one another; rather, to evaluate each independently. As this Project will primarily support the Key Project Purpose, the core objectives will receive 50% of the overall weighting and the supporting objectives share the remaining 50% of the overall weighting. **Table 2** summarizes the initial weighting scheme of each objective.

Table 2: Screening Process Results

Objective	Classification	Poll Weight	Objective Baseline Weight
Flood Hazard Reduction	Core Objective	55%	27.5%
Groundwater Recharge	Core Objective	45%	22.5%
Water Quality	Supporting Objective	15%	7.5%
Water Supply	Supporting Objective	13%	6.5%
System Sustainability	Supporting Objective	17%	8.5%
Ecosystem	Supporting Objective	13%	6.5%
Agricultural Land	Supporting Objective	17%	8.5%
Undeveloped Land	Supporting Objective	14%	7.0%
Community Benefits	Supporting Objective	10%	5.0%

Note: Percentages do not sum to 100% due to rounding.

2.2.2 Concept Evaluation

To prioritize the concepts, it is necessary to evaluate how well each concept satisfies the nine objectives. It is important to note that for the Scoping Study, the concepts have a low level of detail available for evaluation. Since specific proposals and locations are not being evaluated, this portion of the prioritization process must be done at a high level, equivalent to the level of detail available about each concept. The ability of a concept to fulfill an objective is quantified using the following system:

- 3 - Provides a high level of benefit associated with the objective;
- 2 - Partially meets the objective;
- 1 - Uncertain ability to fulfill intent of objective; and
- 0 - Does not fulfill objective.

Uncertain ability to fulfill intent of the objective at this stage of concept development could be due to high dependence on location or project features (details to be developed following the Scoping Study) or the nature of the concept is open ended at this time. This uncertainty reflects the options that need to be tailored on a case-by-case basis to fit the local environment and conditions.

Table 3 summarizes the scores attributed to each concept and objective pairing.

Table 3: Concept-Objective Evaluation Summary

Objective	Managed Floodplain	Off-stream Detention Basin	In-stream Detention Basin	Floodplain Modification	Channel Modification	Bypass Channel	Low Impact Development	Policy Review and Development
Flood Hazard Reduction	1[1]	3	3	3	3	3	1	1
Groundwater Recharge	1[1]	1[3]	1[3]	1[3]	1[3]	1[2]	1[3]	1
Water Quality	1	2	2	2	1	1[2]	2	1
Water Supply	1[3]	1[3]	1[3]	1[3]	1[3]	1[3]	2	1
System Sustainability	3	3	1[2]	3	2	2	3	1
Ecosystem	3	3	0	2	1	3	1	1
Agricultural Land	3	1	1	2	2	1[4]	3	1
Undeveloped Land	3	2	2	2	2	1[4]	3	1
Community Benefits	1[2]	1[2]	1[2]	1[2]	1[2]	1[2]	1[2]	1

Footnotes:

[1] Maintains existing benefit. In the case of flood hazard reduction, the benefit has been deemed critical to the success of downstream flood control projects.

[2] Score due to dependency on project features that may or may not be part of the implemented project.

[3] Score due to dependency on project location that has yet to be determined.

[4] Score assumes a surface bypass.

2.2.3 Baseline Prioritization Results

RMC used Criterium Decision Plus (CDP) to evaluate the concept priorities. CDP is a visual decision tool that allows users to select and modify criteria to evaluate concepts. For this Project, CDP utilizes user inputs, such as the objective weightings and concept scores described above, to generate a prioritization score for each concept. The scores are then used to understand how well the concept is aligned with the objectives and overall priorities of the Project. Concepts with high scores better fit the objectives of the Project than concepts with low scores. **Table 4** summarizes the results of the simulation and ranks each concept.

Table 4: Baseline Prioritization Results

Rank	Concept	Score
1	Floodplain Modification	0.67
1	Off-stream Detention Basin	0.67
3	Channel Modification	0.6
4	Bypass Channel	0.59
5	In-stream Detention Basin	0.54
5	Managed Floodplain	0.54
5	Low Impact Development	0.54
8	Policy Review & Development	0.33

3 Prioritization Confirmation

The preliminary prioritization results are a good indication of how the eight concepts might be ranked against one another; however, several checks were performed prior to moving forward with a recommendation for concepts to be included in the Feasibility Study. These checks addressed uncertainty in the objective weighting, cost implications, and significant hurdles that would need to be overcome in the implementation stage of the project.

3.1 Sensitivity to Objective Weighting

RMC performed sensitivity analyses on the results of the baseline prioritization by varying the weighting of the objectives. Five additional simulations were performed as follows:

- Core Objective Emphasis – Increase relative weight of the core objectives to 65% and decrease the relative weight of the supporting objectives to 35% (as opposed to the baseline 50%-50% split).
- Water Emphasis – Double the relative weight of the Water Quality and Water Supply objectives compared to the baseline weighting.
- Environment Emphasis – Double the relative weight of the System Sustainability and Ecosystem objectives compared to the baseline weighting.
- Land Use Emphasis – Double the relative weight of the Agricultural Lands and Undeveloped Lands objectives compared to the baseline weighting.
- Community Emphasis – Double the relative weight of the Community Benefits objective compared to the baseline weighting.

The additional simulations had similar prioritization orders for the concepts. Based on the results shown in **Table 5**, it is possible to conclude that the results of the analyses are not highly sensitive to changes in criteria weighting as described in this section considering:

- The top three concepts in the Baseline scenario are ranked in the top three places for all sensitivity scenarios except for one (Environment Emphasis), where one concept is ranked 4th.
- The top four concepts in the Baseline scenario are ranked in the top four places for all sensitivity scenarios except for Water Emphasis (where one concept is ranked 5th) and Land Use Emphasis (where one concept is ranked 7th.

Table 5: Weighting Scenario Prioritization Results

Concept	Baseline Weighting	Core Emphasis	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Floodplain Modification	1	1	1	2	1	1
Off-stream Detention Basin	1	1	2	1	3	2
Channel Modification	3	3	3	4	2	3
Bypass Channel	4	4	5	3	7	4
In-stream Detention Basin	5	5	3	7	6	5
Managed Floodplain	5	6	7	5	4	6
Low Impact Development	5	6	6	6	4	6
Policy Review & Development	8	8	8	8	8	8

See **Appendix A** for additional detail on objective weighting for the various scenarios as well as final scores.

3.2 Cost Considerations

Based on overall cost and funding opportunities for multiple benefit concepts, it appears that implementation cost should not be considered a fatal flaw for any of the concepts at this time. However, the cost for constructing a buried off-stream detention basin (one potential technique for the off-stream detention concept) is anticipated to be high and this additional cost does not seem to be off-set by a commensurate increase in benefits. A buried bypass channel would also have a high construction cost with limited additional benefits over a surface bypass. Unless additional funding becomes available for these particular project concepts, for example from a developer that wanted to use the land above the basin, burying a detention basin or bypass channel does not appear justified.

3.3 Implementation Feasibility

At this stage of project development, none of the concepts included in the prioritization process are deemed to be inherently flawed from an implementation perspective. In-stream detention basins, though,

would likely require significantly more mitigation and maintenance than the other concepts and could be difficult to permit except in some exceptional cases. Comparable benefits could likely be obtained through other concepts in the prioritization. For these reasons, in-stream detention basins are not recommended for inclusion in the Feasibility Study.

Similarly, channel modifications also have in-stream, channel bottom impacts along the length of the project. Since this concept does not impede sediment transport or biological passage though, the permitting and maintenance requirements are expected to be less than in-stream detention basins. With the above limitations in mind, channel modifications should be considered primarily as a location-specific solution and where possible not be a primary element in the solution to the flooding and groundwater recharge issues.

3.4 Recommended Concept Prioritization

Due to the location dependent nature of these concepts, the concepts have been assigned to prioritized tiers as differentiation within the tiers is difficult to justify at this time. The first tier includes the concepts that appear to fit the objectives of this Project and do not have overriding considerations described in the section above. Concepts in this tier should form the basis of the project concepts developed during the Feasibility Study. The second tier includes concepts that could be used to support project concepts based on the first tier concepts. The third tier includes concepts that would not normally be considered for implementation through this Project. The enhancement tier includes concepts that could be paired with concepts implemented as part of the Project to bring additional benefits. The recommended tiers for concept prioritization are:

- First Tier
  - Floodplain modification
  - Off-stream detention basin (surface)
- Second Tier
  - Channel modification
  - Bypass channel (surface)
- Third Tier
  - Off-stream detention basin (buried)
  - Bypass channel (buried)
  - In-stream detention basin
- Enhancement Tier
  - Managed floodplain
  - Low impact development
  - Policy review and development

Detention basin and floodplain modification concept locations will be dependent upon a willing land owner, zoning, and some geophysical considerations such as a low slopes and proximity to potential recharge zones. These first tier concepts are anticipated to be the primary methods through which to achieve flood hazard reduction and groundwater recharge. Channel modification and surface bypasses envisioned to be used as a solution to local flooding, as opposed to a regional solution. As such, they can be used to supplement the protection benefits of the overall project. Modeling will be required for any proposed project to evaluate hydraulic feasibility and to confirm that upstream hydromodification does not induce flooding in downstream reaches.

The three concepts included in the enhancement tier are fundamentally different from the construction projects in the first three tiers. These concepts are not recommended to be the basis of future feasibility

work. They do however provide benefits and could be used to supplement other projects. A short description of each enhancement concept and how it could be implemented is included below:

- Managed floodplain –This concept maintains the existing flood protection levels rather than reducing flood hazards. The U.S. Army Corps of Engineers has indicated that the attenuation provided by the upstream floodplains plays an important role in maintaining the effectiveness of the downstream flood control projects. It is therefore recommended that whenever possible, the Water Agency partner with the City of Petaluma and other agencies, including local open space and agricultural land preservation organizations to achieve maintenance of the existing attenuation benefits.
- Low Impact Development – Low impact development (LID) projects are typically not effective during large rain events as they are easily overwhelmed by large flows, thus reducing their flood protection benefit. They are, however, innovative ways to reduce stormwater runoff, promote infiltration, and improve water quality through development or redevelopment of areas. Additionally, the implementation costs for LID projects can oftentimes at least partially be offset by private developers. It is recommended that the Water Agency encourage implementation of LID projects by those agencies with oversight and control of land use activities.
- Policy Review and Development – Many decisions that impact stormwater runoff or recharge potential are made by entities that control land use and development. This is a concept that could help preserve existing resources and potentially improve conditions. It is therefore recommended that the Water Agency work with the City of Petaluma and Sonoma County to implement this or a similar concept.

4 Next Steps

Following review by the Water Agency, feedback from the public on this memorandum will be solicited. Based on that feedback and the input of regulatory agencies, the Water Agency will recommend any final edits to this memorandum prior to it being finalized.

The highest priority concepts described herein will form the basis of the Feasibility Study scope of work and implementation plan that will be developed as part of the Scoping Study. The Feasibility Study will identify candidate locations for the priority concepts; fill data gaps as necessary to further evaluate the feasibility of the concepts; confirm the flood hazard reduction and groundwater recharge benefits; and develop concept details to support project definition and funding applications. The Feasibility Study will also confirm that projects selected for potential implementation would, at a minimum, not have a negative impact on downstream flood protection projects. The Implementation Plan will help the Water Agency plan for future Project efforts and identify the steps and milestones as the Project moves forward.

Appendix A: Prioritization Sensitivity Scenarios

As described in the body of this memorandum, additional weighting scenarios were developed to test the sensitivity of the Baseline concept prioritization to objective weightings. The objective weights for the five sensitivity scenarios are summarized in **Table A1**.

By adjusting the weighting of the objectives in the five alternate scenarios, different strengths and weaknesses of the concepts are revealed. The concepts that are consistently at the top of each or most of the weighting scenarios are likely the strongest and the most likely to most completely fulfill the objectives of the Project.

Table A1: Objective Weighting Scenarios

Objective	Baseline Weighting	Core Emphasis[1]	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Flood Hazard Reduction	27.5%	35.8%	27.5%	27.5%	27.5%	27.5%
Groundwater Recharge	22.5%	29.3%	22.5%	22.5%	22.5%	22.5%
Water Quality	7.5%	5.3%	15.0%[2]	4.3%	4.2%	6.7%
Water Supply	6.5%	4.6%	13.0%[2]	3.8%	3.6%	5.8%
System Sustainability	8.5%	6.0%	5.3%	17.0%[2]	4.8%	7.6%
Ecosystem	6.5%	4.6%	4.0%	13.0%[2]	3.6%	5.8%
Agricultural Land	8.5%	6.0%	5.3%	4.9%	17.0%[2]	7.6%
Undeveloped Land	7.0%	4.9%	4.3%	4.1%	14.0%[2]	6.3%
Community Benefits	5.0%	3.5%	3.1%	2.9%	2.8%	10.0%[2]

Footnotes:

[1] Balance of the objective weighting in this scenario is 65% for core objectives and 35% for supporting objectives. In all other scenarios, the balance is 50% for core objectives and 50% for supporting objectives, as it is for the baseline scenario. Core objectives are always at least 50% of the evaluation weight as they directly support the Key Project Purpose.

[2] Objective weighting is double the baseline scenario weighting for the highlighted cells

Criterium Decision Plus (CDP) was used to evaluate the concepts using the above weighting scenarios. The same concept-objective evaluation scores as were used in the baseline scenario. **Table A2** summarizes the scores and ranks for each concept for the weighting scenarios.

Table A2: Weighting Scenario Prioritization Results

Concept	Baseline Weighting	Core Emphasis	Water Emphasis	Environment Emphasis	Land Use Emphasis	Community Emphasis
Floodplain Modification	1 (0.67)	1 (0.68)	1 (0.65)	2 (0.72)	1 (0.68)	1 (0.66)
Off-stream Detention Basin	1 (0.67)	1 (0.68)	2 (0.64)	1 (0.74)	3 (0.63)	2 (0.65)
Channel Modification	3 (0.6)	3 (0.63)	3 (0.57)	4 (0.6)	2 (0.64)	3 (0.59)
Bypass Channel	4 (0.59)	4 (0.62)	5 (0.56)	3 (0.66)	7 (0.56)	4 (0.58)
In-stream Detention Basin	5 (0.54)	5 (0.59)	3 (0.57)	7 (0.5)	6 (0.57)	5 (0.54)
Managed Floodplain	5 (0.54)	6 (0.48)	7 (0.46)	5 (0.59)	4 (0.6)	6 (0.52)
Low Impact Development	5 (0.54)	6 (0.48)	6 (0.53)	6 (0.53)	4 (0.6)	6 (0.52)
Policy Review & Development	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)	8 (0.33)

Footnotes: Values shown are Rank and (Score).